



# Travel behaviour of seniors in Eastern Europe: a comparative study of Brno and Bratislava

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## Abstract

**Purpose** Although seniors represent a sizable group of a population with distinctive travelling needs, we lack knowledge about their travel behaviour related to usage of public transport in the context of Eastern Europe. This study aims to describe patterns of travel behaviour of senior citizens in two cities with similar size and key mobility characteristics – Brno (Czech Republic) and Bratislava (Slovakia).

**Methods** The data was collected via travel behaviour survey. The final sample from Bratislava consisted of 1961 seniors of the age of 70 and older who accounted for 3343 trips. The final sample in Brno contained 63 seniors of the age of 70 years and older who conducted 151 trips.

**Results** On average, inhabitants of Bratislava older than 70 years conducted 1.7 trips per day, whereas it was 1.5 trips per day in Brno. The seniors from Bratislava averagely spent 40 min on their trips per day and single trip usually took 24 min to them. In comparison, senior citizens from Brno mostly needed 28 min per single trip, albeit their daily travel took almost the same time (41 min). When it comes to mode choice, while seniors from Bratislava prefer walking the most (44%), their counterparts from Brno predominantly chose public transport (57%).

**Conclusion** In summary, seniors from Brno aged 70 years and over use public transport significantly more than their counterparts from Bratislava. As a result, public transport allows them to travel further, which in turn gives them more opportunities to satisfy their needs.

**Keywords** Seniors · Travel behaviour · Mode choice · Brno · Bratislava

## 1 Introduction

The population of post-industrial countries is ageing. This well-documented phenomenon has resulted in an increased

need for understanding travel behaviour of seniors as a significant and growing population group [1]. Researchers in industrialised countries have focused on areas such as the association between travel behaviour of seniors and their health [2], availability of travel modes and their lifestyle [3], or shopping trips for older and physically challenged people [4]. However, not all industrialised countries facing the same problems have been studied to the same extent. For example, travel behaviour of seniors related to mode choice has received no attention in the Eastern European countries such as the Czech Republic and Slovakia.

Both the Czech Republic and Slovakia have much the same age structure of the population and face similar demographic processes. The aging population is partly due to a structural change due to increasing life expectancy and decreasing fertility. The ratio of the population over 65 years in the Czech Republic is 18.4% [5] and in Slovakia 12.7% [6]. According to population predictions, by the year 2030, the proportion of the population over 65 years will be 23.9% in

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the Czech Republic and 21.6% in Slovakia [7, 8]. Based on that evidence, the role of seniors in urban populations is beginning to be important and will be crucial in the near future.

However, even from today's perspective seniors represent a significant sub-population. They are such sub-population not only in terms of prospective consumers [9], but also in terms of citizens facing specific challenges such as cognitive or physical impairments. Their needs and limitations must be considered to maintain seniors' access to activities such as social visits, shopping, or visiting a doctor [1]. In other words, to remain healthy and fulfilled, seniors need to have the capacity to satisfy their travel needs. As a result, the access to activities is associated with higher levels of psychological well-being, positive self-perception [10], or social activities [11]. On the other hand, limited access to activities reduces possibility to satisfy one's life needs. Such an outcome is related to various issues with a policy-making relevance including the development of depression [12].

Among other factors, the access to activities depends on various aspects such as quality (or a mere existence) of public transport or the possibility to use a passenger car. The latter alternative applies in particular when there is no mode-choice alternative present or when costs of the alternative (including its attractiveness) are high [13]. As a result, in cities and rural areas with insufficient public transport service a passenger car may be the crucial element of mobility, whereas in dense urban areas it could be replaced with different mode choices [14, 15].

All in all, passenger cars remain the favourite transportation mode for people older than 64 in Western Europe [4], the United States [14], or Australia [1]. Various factors can influence this situation. Initially, the increasing distance (in both time and space) between a residence and the nearest public transport stop decreases the willingness of seniors to use public transport. Moreover, interchanges during one trip tend to discourage seniors from using public transport [16]. Another contributing factor is the accessibility of public transport reflecting physical and cognitive impairments of the seniors, which could be achieved (e.g.) through employing low-floor buses [17].

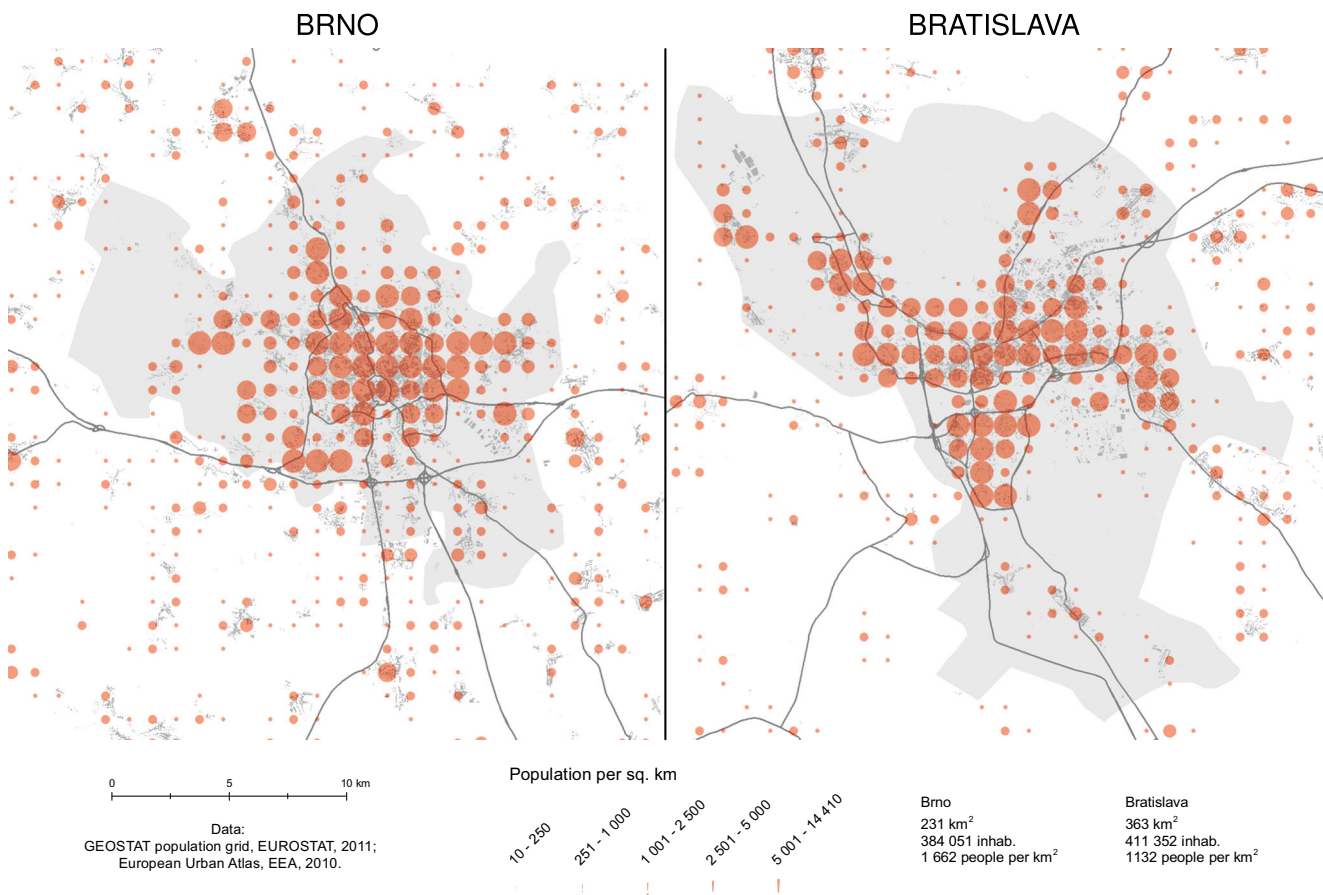
Those impairments are also related to the ownership of a driving licence, i.e. another factor influencing mode choice. Relatively frequent driving skill assessments in older age may result in losing a driving licence and driving ceasing. In addition, not being able to drive a car is more and more frequent with the increasing age of seniors. Driving cessation in return significantly influences individual's lifestyle, especially because of its pressure to change well-established and previously functional behavioural pattern of a car driving [2]. Driving cessation (along with unavailable alternative mode choices) could be challenging since active lifestyle is mobility-demanding [3]. In the case of not being able to drive anymore, some seniors may turn to their relatives or other persons

within their social network [18]. However, the social network may not have the capacity to cover all the trips. Furthermore, this issue has a gender dimension as fewer women own driving licenses in comparison to their male counterparts. The lack of transportation alternatives burdens older women more than older men [3].

Travel behaviour of seniors in Eastern European countries might be comparable to previously studied regions such as Western Europe, USA, Canada or Australia regarding the level of urbanisation. However, there are also possible cultural, societal and historical differences that question mechanical extrapolation from one context into another. Only recently, several travel behaviour surveys (TBS) have been conducted in the Czech Republic and Slovakia. In 2013 (mid-May to June), an international travel behaviour survey was carried out in border regions of the Czech Republic, Austria, and Slovakia as a part of the project 'Transport model AT-CZ'. The main purpose of the survey was to compile and parameterize the transport model of the South Moravian Region in the Czech Republic [19]. Brno, the major city in the region, was one of the studied areas of the research (hereafter TBS Brno). Moreover, in 2014 (June, September to mid-November), a travel behaviour survey in the city of Bratislava (TBS Bratislava) was conducted as a part of Transport Master Plan of Bratislava, the capital of Slovakia. The purpose of the TBS Bratislava was to provide necessary information for purposes of multimodal transport model and transport planning measures.

In this study, we utilised the data collected in the survey to focus on the travel behaviour of senior citizens in Brno and Bratislava. Both cities have a similar area, population, the share of inhabitants over 60 years, urban structure and development history, transport system and its conditions for seniors [5, 6]. Rapid residential development is typical for Brno and Bratislava and could be characterised by the concept of microdistrict in the era of socialist cities [20]. After 1989, both cities witnessed a gradual lately upward suburbanization and reurbanisation due to structural economic and social changes in both countries. Urban structure of both cities is therefore very similarly characterised by one historical urban core surrounded by dense residential and industrial areas from the socialist era and light residential suburban areas in places (Fig. 1).

The aim of the study is to explore mode choice as an important aspect of travel behaviour of seniors in the two principal cities in Eastern Europe, the area with no previous coverage on the topic. To provide a more comparable insight, we decided to focus on the two age groups: 60–69 years old and over 70. It is because seniors who are over 70 have access to free public transport in both cities. In addition, the price of public transport is reduced for seniors over 60 in Brno, but not in Bratislava [21, 22]. We use multinomial logit model for mode choice which tests socioeconomic variables,



**Fig. 1** Urban structure and spatial distribution of the population in Brno, Czech Republic, and Bratislava, Slovakia in 2011

demographic variables and travel time as the attribute of the trip, in order to explore sources of potential differences in mode choices by seniors in the studied cities. The outcome of this study is, therefore, relevant especially for policymakers since it represents the basis for an informational database. Moreover, by focusing on the under-researched region, we aim to provide useful insights which can be used by other societies [3].

## 2 Methods

### 2.1 Sample

TBS Bratislava was conducted by random walk method with pre-determined starting points, which served as a sampling method. The sample of respondents was stratified by geographic zones, which were delimited within the city. Interviewers contacted every second house in the case of family houses or every second entrance door along with every fifth household in the case of a block of flats. Interviewers also followed the rule of right hand after finishing an interview and choosing another house to inquire or upon reaching the end of a street. The proportion of interviewed households

within individual zones relative to the total sample size reflected their relative share to the total number of households in Bratislava. The final sample, consisting of 19,457 respondents belonging to one of the 10,115 households, represented with more or less precision the structure of population according to the latest census [6]. The study accurately represented seniors older than 60 years as their proportion (22.5%) in the sample was almost the same as in the population [6]. Thus, in the sample, there were 4375 seniors aged 60 and older who accounted for 7856 trips.

The sample in the TBS Brno consisted of 1092 households and 2631 persons selected via the same procedure as in the case of TBS Bratislava. Respondents older than 60 accounted for 7.3% of the total sample size. Also, they conducted 323 trips.

### 2.2 Survey techniques

Both studies were conducted in a similar way. In the Bratislava study, the data was collected via survey. Authors of the study originally wanted to include two ways of data collection – paper and pencil interviewing (PAPI) and computer assisted web interviewing (CAWI). Almost 90% of households participating in the research chose PAPI over

CAWI. The similar situation arose in TBS Brno, where PAPI was the only used method of data collection. Both TBSs were methodologically based on KOMOD [23] adapted to the local setting.

In both studies, the survey consisted of a questionnaire dedicated to the household. Also, each participant was asked to fill his or her individual part of the questionnaire. The core of the questionnaire was a travel diary (see [24]) for each of the household members older than 6 years. It consisted of items related to the mode of the travel, the destination, or the trip purpose. Moreover, respondents had to fill in mobility-relevant items (e.g. ownership of a car, the number of bicycles in the household, or a possibility of home-office) and items related to the socio-economic context (e.g. size of the household, a level of education, gender or age) [2].

### 2.3 Design

The TBS Bratislava was conducted in 2014. Throughout the year, 19,457 households (out of total 172,000, i.e. 11%) were asked to participate in the research. Overall, the interviewers were able to contact a gross sample [25] of 30,300 households. The response rate [26] equalled 50%. Lastly, the authors of the study applied indicators of data quality [27], again according to KOMOD methodology [23]. That included a minimum acceptable response rate (at least 50% or more) or an adequate coverage of each of the sampling area.

The TBS Brno was carried out in May and June 2013. The response rate equalled to 68% [26].

## 3 Results

### 3.1 Descriptive statistics

Brno and Bratislava differed in many important mobility characteristics such as the modal-split in both the cities. Seniors between of age between 60 and 69 in Brno used public transport in 70% of their trips, whereas their counterparts in Bratislava did so only in 37% of their trips. The most used mode for the seniors of Bratislava older than 70 years was also walking (49%). In comparison, the share of walking as a mode choice was lower in Brno (35%) as well as usage of passenger cars.

Albeit women constituted a higher proportion of the sample in comparison to men, the gender of the respondents was distributed roughly the same in both studies. On the other hand, there was a larger share of seniors in Brno with a driving license and having at least some access to a passenger car and a bicycle. Lastly, the majority of the participants in both cities achieved a high school diploma or higher level education (ISCED34) [31]. For further information see Table 1 and Table 2:

**Table 1** Descriptive statistics of the participants in TBS Bratislava

	Bratislava			
	60–70		70+	
	N	%	N	%
Total persons within the age category	2499	–	1876	–
Gender				
Women	1362	54	1057	56
Men	1137	45	819	44
Educational level				
Vocational education or lower (ISCED35)	644	26	773	41
High school diploma or higher (ISCED34)	1845	74	1093	59
Mobility-relevant variables				
Driving license ownership	1233	49	545	29
Car available (at least sometimes)	989	40	384	20
Bike available (at least sometimes)	730	29	291	16
Total trips within the age category	4913	–	2943	–
Mode choice				
Car as a driver	838	17	241	8
Public transport	1821	37	1076	37
Car as a passenger	251	5	129	4
Bike	60	1	42	1
Walk	1943	40	1455	49

**Table 2** Descriptive statistics of the participants in TBS Brno

	Brno			
	60–70		70+	
	N	%	N	%
Total persons within the age category	90	–	102	–
Gender				
Women	45	50	53	52
Men	45	50	49	48
Educational level				
Vocational education or lower (ISCED35)	33	37	45	44
High school diploma or higher (ISCED34)	57	63	57	56
Mobility-relevant variables				
Driving license ownership	59	66	48	47
Car available (at least sometimes)	48	53	35	34
Bike available (at least sometimes)	45	50	21	21
Total trips within the age category	182	–	141	–
Mode choice				
Car as a driver	47	26	9	6
Public transport	70	38	76	54
Car as a passenger	17	9	6	4
Bike	2	1	0	0
Walk	46	25	50	35



### 3.2 Mode-choice model

Multinomial logit model [28, 29] was used to model the mode choice. The data entering the model consisted of trips of seniors from Brno and Bratislava shorter than 10 km. The final number of trips equalled to 8075 of seniors older than 60 years in Brno and Bratislava (see Table 3). The included travel modes were car as a driver (CD), car as a passenger (CP), public transport (PT), and walking (W). The bicycle was removed from the list because of a limited number of trips conducted by this mode of travel. The data about the trip entered the model as the panel data.

The model included variables such as the achieved level of education (vocational education or lower and high school diploma or higher) as an indicator of the socioeconomic status, the gender of the respondents, and age groups (60–69 years old and older than 70 years). The model tested differences in utility for each of the four included mode choices – car as a driver, car as a passenger, public transport and walking. The differences were tested between both cities (Brno and Bratislava), both age categories (60–69 and 70+), and the interaction between these two variables. Moreover, the model tested differences in utility (or preference) between men and women or the two educational groups. The final model (adjusted  $\rho^2 = 0.466$ ) contained 10 statistically significant parameters. These significant parameters are described further in Table 4:

The utility equations for each one travel mode alternative are described below:

$$\begin{aligned}
 U_{CD} &= ASC_{CD} + \beta_{itCD} tt_{CD} + \beta_{townageCD}(1-town) \\
 &\quad age + \beta_{genCD}gender + \beta_{car} car + \beta_{dlic}dlic \\
 U_{CP} &= ASC_{CP} + \beta_{itCP} tt_{CP} + \beta_{eduCP}edu \\
 U_{PT} &= ASC_{PT} + \beta_{itPT} tt_{PT} + \beta_{genPT} gender \\
 U_W &= \beta_{itW} tt_W + \beta_{genW} gender + \beta_{townW} town
 \end{aligned}$$

All statistically significant parameters of the estimated model are shown in Table 5:

There was no statistically significant difference between respondents from Brno and Bratislava in terms of preference for public transport. The model showed that seniors from Brno older than 70 years were unwilling to use car as a driver ( $\beta_{townageCD}$ ) in comparison to their peers in Bratislava. Moreover, seniors in Bratislava were significantly more willing to walk in comparison to seniors from Brno ( $\beta_{townW}$ ).

**Table 3** Number of trips per city and age category

	Bratislava	Brno	Total
60–70	4853	180	5033
70+	2901	141	3042
Total	7754	321	8075

Also, the model found lower utility in car driving for women in comparison to men ( $\beta_{genCD}$ ) regardless of the city they lived in. The same tendency was present in using public transport ( $\beta_{genPT}$ ) and walking ( $\beta_{genW}$ ) as mode choices. Lastly, respondents who achieved high school diploma or higher level of education were more likely to drive in a car as passengers relatively to the respondents who achieved lower level of education ( $\beta_{eduCP}$ ).

When we take into account the modal split (see Table 1 and Table 2), the difference between the actual usage of public transport by seniors older than 70 years from Brno and Bratislava could not be explained solely by their willingness to use the public transport. Rather, the explanation lies in the willingness of the seniors from Bratislava to walk and the substantial unwillingness of the seniors from Brno to drive a car.

### 4 Conclusions and discussion

In summary, seniors from Brno aged 70 years and over use public transport significantly more than their counterparts from Bratislava. As a result, public transport allows them to travel further, which in turn gives them more opportunities to satisfy their needs.

The analyses provide insightful and rather unexpected results, at least in an international context [1, 4, 14]. Public transport and walking are the most frequent travel modes in both cities initially. However, seniors in Brno and Bratislava do not unequivocally choose public transport. In Bratislava, almost half of all trips conducted by seniors were made on foot, despite the fact that public transport is free for seniors over 70 years in both cities and even though the spatial availability of public transport stops is similar in both cities. The spatial distribution of public transport stops in Brno and Bratislava does not indicate any principal difference in the average walking time from the residence of inhabitants to the nearest stop.

Another influential factor might be an availability of public transport vehicles for seniors measured by share of low-floor vehicles (LFV) within Brno and Bratislava. According to [30, 31], there share of LFV in the bus fleet is 42% in Brno and 40% in Bratislava. Albeit the share is similar in both cities, the distribution of LFV between public transport subsystems might be one of the factors explaining the difference in public transport usage. In Bratislava LFVs were almost solely present in bus fleets, so only destinations serviced by buses were easily accessible for persons with physical impairments. On the other hand, in Brno LFVs are equally distributed, and all public transport subsystems provide similar quality service for citizens with impairments.

Additionally, there is no difference between seniors from Brno and Bratislava in terms of preference of public transport

**Table 4** Significant parameters of the model

Parameter	Description
$ASC_{CD}$	Alternative specific constant for using a car as a driver.
$ASC_{CP}$	Alternative specific constant for using a car as a passenger.
$ASC_{PT}$	Alternative specific constant for using public transport.
$\beta_{townageCD}$	The difference of alternative specific constant for using car as a driver for seniors 70+ living in Brno. Variable $town = 0$ indicates living in Brno and variable $age = 1$ indicates age 70+.
$\beta_{townW}$	The difference of alternative specific constant for walking for seniors living in Bratislava and Brno. Variable $town = 1$ indicates living in Bratislava
$\beta_{ttCD}$	The utility of travel time by car as a driver in the natural logarithm of minutes.
$\beta_{ttCP}$	The utility of travel time by car as a passenger.
$\beta_{ttPT}$	The utility of travel time by public transport.
$\beta_{ttW}$	The utility of travel time by walk in minutes.
$\beta_{dlie}$	Additional utility for using a car as a driver if the respondent was driving license owner.
$\beta_{car}$	Additional utility for using a car as a driver if the respondent has used a car.
$\beta_{genCD}$	The difference of alternative specific constant for using a car as a driver if the respondent was female. Variable $gender = 1$ indicates that respondent was female.
$\beta_{genPT}$	The difference of alternative specific constant for using public transport if the respondent was female.
$\beta_{genW}$	The difference of alternative specific constant for walking if the respondent was female.
$\beta_{eduCP}$	The difference of alternative specific constant for using a car as a passenger if the respondent achieved high school diploma or higher level of education. Variable $edu = 1$ indicates achieved high school diploma or higher level of education.

usage. In other words, seniors from Brno do not prefer public transport more than their counterparts from Bratislava. However, they differ when it comes to walking and driving a car. The seniors from Bratislava are more willing to walk and those seniors older than 70 years are more willing to drive a car in comparison to their counterparts from Brno. These different attitudes lead to the lower share of public transport

usage in the modal split in Bratislava. Therefore, preference for a certain mode of travel also depends on the preference of other modes. In this study, the different share of public transport in the modal split is related to the different preferences for driving a car and walking in both cities.

**Table 5** Estimated parameters

Parameter	Value	Std. Err.	t-test	p
$ASC_{CD}$	-7.460	0.320	-23.310	0.000
$ASC_{CP}$	-8.820	0.425	-20.780	0.000
$ASC_{PT}$	-3.890	0.200	-19.430	0.000
$\beta_{townageCD}$	-1.420	0.396	-3.600	0.000
$\beta_{townW}$	0.714	0.148	4.820	0.000
$\beta_{ttCD}$	-0.755	0.168	-4.490	0.000
$\beta_{ttCP}$	-0.513	0.191	-2.690	0.010
$\beta_{ttPT}$	-0.862	0.119	-7.270	0.000
$\beta_{ttW}$	-2.170	0.086	-25.200	0.000
$\beta_{dlie}$	3.560	0.123	29.000	0.000
$\beta_{car}$	0.631	0.119	5.290	0.000
$\beta_{genCD}$	-2.290	0.153	-14.980	0.000
$\beta_{genPT}$	-1.150	0.132	-8.700	0.000
$\beta_{genW}$	-1.240	0.140	-8.850	0.000
$\beta_{eduCP}$	0.597	0.178	3.350	0.000

The explanation may be financial since ticket prices related to the average pension of seniors aged below 70 years was four times higher in Bratislava than in the case of Brno. Because of the significantly lower ticket prices in Brno, costs of this mode for the seniors is rather small. Moreover, interchanges do not necessarily discourage seniors from using public transport [16] in Brno since it is reliable, frequent and operates routes that have remained almost unchanged over the years. In other words, seniors in Brno are more accustomed to a usage of public transport even before they reach the age of 70. Behavioural habits regarding travel behaviour also applies for seniors from Bratislava; seniors living in Bratislava may have found a way how to satisfy their needs such as shopping within a reachable distance by walking. It seems that to meet their travel needs, they are capable of planning and carrying out chain trips solely by walking or with its combination with public transport. However, there is another and rather unpleasant way to interpret the results, and that is that seniors in Bratislava resign to conduct certain relatively costly trips. For example, physical impairments may significantly reduce willingness to use public transport unadjusted for these impairments.

Either way, the dominant preference for walking as a mode choice among the oldest inhabitants of Bratislava should be a

matter of interest for policy makers. It is without doubt that walking is beneficial for various outcomes such as health [10]. However, previously mentioned impairments may result in decreased mobility and therefore significantly affect seniors' ability to satisfy their needs, especially during later parts of their lives [3]. Moreover, when a key point of interest such as a grocery shop or medical ambulances moves out of the previously accessible location, seniors may be left without an alternative available. This possibility is important especially in shopping related trips since they constitute the most common travel purpose among seniors [4].

Previously mentioned unavailability could be prevented by providing public transport more aligned with impairments and needs of the seniors, as has already begun in Bratislava and as has been applied in Brno. Since seniors in Bratislava have experience with public transport, they could include it in their decision-making scheme as an accessible travel mode alternative. At the same time, policymakers in Brno should focus on reasons why seniors living there do not prefer walking as a mode choice. For example, it could be related to the quality of sidewalks and other aspects of transport infrastructure, or their knowledge of a closer alternative to their usual shop may be limited. All in all, seniors from Brno over 60 use public transport the most from all modes.

Interestingly, passenger cars (either as a driver or as a passenger) is the least chosen mode of travel. Firstly, only a limited share of seniors in both cities still have a driving license. Furthermore, even a smaller proportion of the seniors have access to a passenger car. These findings are quite the opposite of what we would expect based on findings from Western Europe [4], USA [14], or Australia [1], i.e. prevalence of passenger car as a dominant travel mode. However, smaller car-dependency of the seniors means they are accustomed to choose implicitly other transport modes and thus driving cessation does not have such a critical impact on their lives, both in terms of physiological and psychological health [2] since they are already accustomed to walking or using public transport. However, respondents with a higher level of education were more willing to use a car.

One of the most significant limitations of the study is a rather small sample in the case of Brno as the limited sample size limits capacity to work with a more complex prediction model (in terms of more variables included in the equation). A model that would reflect the reality in a more reliable way since it would have included relevant psychological factors or more generally human elements influencing mode choice. In addition, psychological factors such as perceptions or attitudes, are not present in the current study. Since the prediction model of mode choice explained almost half of the variability, a significant proportion of the variance remains to be explained. Subjective factors could help in decreasing this proportion of unexplained variance.

Also, more detailed information about perceptions and attitudes play a major role in understanding nature of travel

behaviour patterns. For example, we do not know if seniors in Bratislava embrace the possibility to walk or whether it is a necessary evil for them. Moreover, we lack data on car driving of a longitudinal nature. For example, we do not know when seniors had to give away their driving license or how large a share of their trips was conducted via passenger car during the time preceding the study. Finally, we do not have any information on seniors' experiences with delivery services such as shopping and carry on demand [32], despite the fact that there is a significant proportion of seniors who do not leave their homes during the day. Therefore, it would be beneficial to further study this topic to investigate these behavioural patterns fully.

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